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PLOTIT-METHOD OF INTERACTIVELY PLOTTING
INPUT DATA FOR THE VORLAX COMPUTER PROGRAM

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SUMMARY

A method of plotting the geometric input to the VORLAX computer program by means of an interactive remote computer terminal is described. The software consists of a procedure file and two programs and was developed for use with the Langley Research Center computer system. The programs and procedure file are described and a sample execution is presented.

INTRODUCTION

The VORLAX computer program uses a sparse set of geometric input data to describe the aircraft configuration being analyzed. The geometry of the configuration can at times become very complex, and it is necessary to plot the configuration resulting from the data in order to ascertain its accuracy. The procedure file and two computer programs described herein provide a method for plotting this data at an interactive graphics terminal. A sample execution of the procedure is presented.

Use of this method allows the configuration to be plotted with any combination of roll, pitch, or yaw angles. Three independent forms of data display are available, and these may be specified in any combination. These are: (1) configurations with or without camber, (2) configurations showing only major panels or only minor panels, and (3) configurations with or without control points plotted. Any section of the plot may be enlarged for examination in greater detail.

The procedure file and computer programs to plot the VORLAX input data have been written to be used in the Langley Research Center computer system which provides a Network Operating System (NOS) and a Tektronix Plot 10 package. Langley Research Center users will find the procedure file and computer programs in mass storage as public files in the catalog of user number 214737C.
DESCRIPTION OF PROCEDURE FILES AND PROGRAMS

A method has been developed for plotting the VORLAX input data which consists of a procedure file and two computer programs. The procedure file PLOTIT and the computer programs READS and PLOTS are described in the following. A sample execution is provided which includes illustrations of the displays.

Procedure File PLOTIT

Procedure file PLOTIT (Appendix A) is used to simplify the plotting procedure. PLOTIT first gets the desired data file and renames it TAPE1. It then gets the binary form of program READS, which reads the input data and prepares files suitable for the subsequent operations. PLOTIT then gets and executes the binary form of PLOTS, which performs the aircraft geometry plotting.

Program READS

Program READS (Appendix B) reads the VORLAX input data from a disc file named TAPE1 and determines the necessary scaling factor in order for the aircraft drawing to fit on the screen.

The data for each of the panels are then read, and the coordinates of a set of points that describe the panels are calculated. These coordinates are stored on three disc files named TAPE3, TAPE4, and TAPE5. These data files will be read by program PLOTS.

Program READS provides the user with two methods of representing the aircraft. The first method displays the aircraft with camber as shown in figure 1(a). The second method shows the aircraft without camber. Figure 1(b) is the aircraft of figure 1(a) without camber.

Program PLOTS

Program PLOTS (Appendix C) reads the data produced by program READS. This program offers the user several variations in the display which are described
in the following sections.

**Rotation of the Aircraft.** - The initial position of the aircraft is a side view with the nose to the left. From this position, it is possible to rotate the aircraft first in roll, then in pitch, and finally in yaw. Positive angles are defined as follows: roll, right wing down; pitch, nose up; and yaw, nose right.

**Additional Independent Variations.** - PLOTS offers two additional independent variations in the display. These variations are: (1) with or without subpaneling and (2) with or without control points. Examples of these variations are shown in figures 1(c) through 1(f). Figure 1(c) shows the aircraft without subpaneling or control points; figure 1(d) has subpaneling added; in figure 1(e) control points only have been added; and in figure 1(f) control points and subpaneling have been added. All of the plots are constructed using orthographic projection.

**Recovery from Input Errors.** - If an error has been made in specifying the input parameters, the execution of PLOTS can be stopped. There are three ways to stop PLOTS while it is executing. These are: (1) enter a value greater than 360 for roll angle, (2) answer any of the questions with STOP, or (3) stop the program while it is plotting by interrupting it with the break key and then entering an S.

Program PLOTS can be restarted at the beginning by sending the command PLOTB to the computer. PLOTB will also restart the program if it is stopped for any other reason.

**SAMPLE EXECUTION**

Figure 2 shows a sample execution of PLOTIT at a remote terminal. The first command gets the procedure file PLOTIT.

```
GET,PLOTIT/UN=214737C
```

The second command initiates the execution of the procedure file.
CALL, PLOTIT(T=VORLAXX)

VORLAXX is the name of the file on which the VORLAX data deck has been stored for this example. The file name in the calling statement can be any name which corresponds to a file on which VORLAX data is stored.

The first question asked by the computer deals with camber in the panels.

DO YOU WANT CAMBER IN THE PANELS? TRUE OR FALSE

If camber is desired in the panels, type in TRUE, otherwise type in FALSE and the camber will be set equal to zero.

The next three questions asked by the computer are concerned with the desired roll, pitch, and yaw angles of the configuration, and are as follows.

INPUT THE ROLL ANGLE FOR THE AIRCRAFT (DEG), > 360 TO STOP.
PITCH ANGLE
YAW ANGLE

The angles desired in degrees, are typed in after the questions. If termination of the program is desired, a value greater than 360 may be typed in for the roll angle.

The next two questions are concerned with the desirability of displaying paneling and control points. The two questions are:

SUBPANELING? TRUE OR FALSE
CONTROL POINTS? TRUE OR FALSE

If these questions are answered TRUE, the subpaneling and control points are incorporated into the plots. If they are answered FALSE, then these quantities are deleted. The plot resulting from the input in figure 2 is presented in figure 3.

If a certain section of the plot needs to be enlarged in order to examine the plotted data more closely, this may be accomplished at the terminal. When the computer has finished plotting, it will print the following statement:

FOR ENLARGEMENT INPUT YES
At this point a hard copy can be made if desired. If any reply except YES is typed in, the computer will ask for a new set of angles. If YES is typed in, the graphics cursor (cross hairs) will appear. The cursor should then be located at the lower left corner [fig. 4(a)] of a rectangular region to be enlarged. A non-control keyboard character should be pressed. This will cause the cursor to disappear. The carriage return is then pressed. This sequence sends the coordinates of the first corner to the computer. The graphics cursor will reappear and should be relocated to the upper right corner of the desired rectangular region [fig. 4(b)]. A non-control keyboard character and the carriage return are then pressed as for the first corner. An enlargement of the region defined by these positions of the graphics cursor is shown in figure 4(c).

When the plot is finished, the computer will again print

```
FOR ENLARGEMENT INPUT YES
```

This allows a further enlargement of a section of the plot if desired.

**CONCLUDING REMARKS**

A plotting routine, PLOTIT, has been developed for plotting the input data for the VORLAX computer program. This program allows the user to plot geometric input data interactively at a remote graphics terminal and thereby ascertain very rapidly whether or not the data is correct.

The routine consists of two programs and a procedure file. These have been designed for use on the Control Data Corporation computer system with a Network Operating System (NOS) and a Tektronix Plot 10 graphics package at the NASA Langley Research Center.
REFERENCES

APPENDIX A

PROCEDURE FILE PLOTIT

This procedure file gets the binary form of READS(READB) and executes it, then gets the binary form of PLOTS (PLOTB) and executes it.

PLOTIT.
RETURN,TAPE3,TAPE4,TAPES.
GET,TAPE1=T.
GET,READB/UN=214737C.
READB.
RETURN,READB.
GET,PLOTB/UN=214737C.
PLOTB.
EXIT.
APPENDIX B

SOURCE LISTING OF PROGRAM READS

PROGRAM READS(INPUT,OUTPUT,TAPE1,TAPE4,TAPE2=OUTPUT,TAPE3,TAPE5)

C THIS PROGRAM READS THE INPUT DATA FOR THE VORLAX PROGRAM

C SO IT CAN BE PLOTTED.

DIMENSION TITLE(8)
COMMON/BLOCK/XOFFSET
LOGICAL CAMBER
REAL LENGTH
READ(1,100)TITLE
READ(1,103)LAX,LAY
READ(1,101)
READ(1,102)NPAN,WSPAN
CALL SIZES(NPAN,LENGTH,XOFFSET,WSPAN)
IF(WSPAN.GT.WSPAN)WSPAN=WSPAN
TESTRTO=LENGTH/WSPAN
IF(LENGTH.GT.WSPAN)WSPAN=LENGTH
REAL Y IS THE WIDTH OF THE PLOTTING SURFACE.
WRITE(3)NPAN,TITLE,TESTRTO
REAL Y=10.0
REAL Y=REAL Y/20
SCALE=REAL Y/WSPAN
XOFFSET=(XOFFSET+WSPAN*5)
WRITE(2,104)
READ 105,CAMBER
DO 200 I=1,5

200 CALL PANRED(SCALE,LAX,LAY,CAMBER)
100 FORMAT(8A10)
101 FORMAT(/)
102 FORMAT(12,48X,F10.0)
103 FORMAT(11X,11X,9X,9I)
104 FORMAT("DO YOU WANT CAMBER IN THE PANELS? ",/,"TRUE OR FALSE")
105 FORMAT(L7)
STOP
END
SUBROUTINE PANELRED(SCALE,LAX,LAY,CAMBER)
COMMON/BLOCK/XOFFSET
COMMON/BLOK0/NAP,XAF(50),ZC(2,50),CORD1,CORD2,C01SIN,C02SIN
COMMON/CANDS/SIN1,SIN2,C0S1,C0S2,DELTAY
COMMON/ROJ1/ROJ,CROSSIZ
LOGICAL CAMBER
INTEGER PRO,RNC
C
C THIS SUBROUTINE READS THE VORLAX DATA FOR A PANEL. EACH TIME IT
C IS CALLED, THE COORDINATES OF A SET OF POINTS THAT DESCRIBE
C THE PANEL ARE CALCULATED AND STORED ON DISC.
C
DIMENSION X(2),Y(2),Z(2),CORD(2),RLE(2)
COMMON/PHI(0)/PHI(100),RO(100),SINE(100),COSINE(100)
COMMON/VORS(3,500)
COMMON/PI/PIE
COMMON/TWIST/AINC,/DAINC
REAL K
DATA ?1E/3.14159,/CROSSIZ/.02/
C
C THIS SECTION READS THE VORLAX DATA CARDS FOR A PANEL.
C
DO 200 I=1,2
  200 READ(1,100)X(I),Y(I),Z(I),CORD(I)
DO 250 I=1,2
  X(I)=X(I)+XOFFSET)*SCALE
  Y(I)=Y(I)*SCALE
  Z(I)=Z(I)*SCALE
  250 CORD(I)=CORD(I)*SCALE
READ(1,101)TVOR,TNCV,PDL
RNCV=INT(TNCV)
NVOR=INT(TVOR)
NVOR1=NVOR+1
IF(PDL.LE.360.)GO TO 1
READ(1,102)(PHI(N),R0(N),N=1,NVOR1)
DO 251 N=1,NVOR1
  PHI(N)=PHI(N)*3.14159/180.
  251 R0(N)=R0(N)*SCALE
READS 34
READS 35
READS 36
READS 37
READS 38
READS 39
READS 40
READS 41
READS 42
READS 43
READS 44
READS 45
READS 46
READS 47
READS 48
READS 49
READS 50
READS 51
READS 52
READS 53
READS 54
READS 55
READS 56
READS 57
READS 58
READS 59
READS 60
READS 61
READS 62
READS 63
READS 64
READS 65
READS 66
READS 67
READS 68
READS 69
READS 70
READS 71
1 READ(1,103)AINC1,AINC2,ITS,NAP,IQUANT,ISYNT,NPP
    AINC1=ATAN(AINC1)
    AINC2=ATAN(AINC2)
    DAINC=AINC2-AINC1
    IF(IQUANT.EQ.0)IQUANT=2
    IF(ISYNT.NE.0)READ(1,104)
    IF(NAP.LE.2)GO TO 2
    READ(1,102)(XAF(I),I=1,NAP)
    DO 88 I=1,NAP
88 XAF(I)=XAF(I)*0.01
    IF(ITS.EQ.0.OR.PDL.GE.360.)GO TO 3
    READ(1,105)RLE(1)
    RLE(1)=RLE(1)*SCALE
    READ(1,102)(ZC(I),I=1,NAP)
    IF(ITS.EQ.0.OR.PDL.GT.360.)GO TO 4
    READ(1,105)RLE(2)
    RLE(2)=RLE(2)*SCALE
    4 READ(1,102)(ZC(I),I=1,NAP)
    IF(.NOT.CAMBER.A.NAP.GT.2)CALL ZEROZC1(PDL)
    CONTINUE
100 FORMAT(4F10.0)
101 FORMAT(2F10.0,10X,F10.0)
102 FORMAT(8F10.0)
103 FORMAT(2F10.0,12X,8X,2.9X,I3,9X,I1,9X,I1)
104 FORMAT(/)
105 FORMAT(F10.0)

C     THIS SECTION CALCULATES THE LOCATION OF A SET OF POINTS
C     THAT DEFINE A FLAT PANEL.
C
C     NVRN=(RNCV)*(NVOR+1)+1
C     NVRNPRD=(RNCV+2)*(NVOR+1)
C     N4=4.0*RNCV
C     N2=2.0*RNCV
C     X1=X(1)
C     CORD1=CORD(1)
C     C***** IF THE PANEL IS CURVED GO TO 5
C     IF(PDL.GT.360.)GO TO 5
C     X2=X(2)
APPENDIX B. - Continued

Y1 = Y(1)
COR02 = COR02(2)
SIN1 = SIN(AINC1)
SIN2 = SIN(AINC2)
COS1 = COS(AINC1)
COS2 = COS(AINC2)
COS2IN = COR01 * SIN1
COS2CO = COR01 * COS1
COS2SIN = COR02 * SIN2
COS2CO2 = COR02 * COS2
Z1 = Z(1)
Z2 = Z(2)
DELTAY = (Y(2) - Y1)
DELTAX = (X2 - X1)
DELTAZ = (Z2 - Z1)
DELTACO = (COS2CO - COS2CO1)
YRAT = SORT (DELTAZ * DELTAY * DELTAY * DELTAY)

C
ISET = ISETS(Y(NVRP)
CALL SAVE (IFUG, 3, IDUM, 1)
WRITE (3) NVOR, RNCP, POL, IQUANT, NVRPRD, ISET
CALL INTERP (0.0, ZZ0, ZZ, X00, XERP)
DO 310 1 = 1, NVOR1
IF (LAX, EQ, 1) RATIO = (I-1.)/NVOR
IF (LAX, EQ, 0) RATIO = 5 * (1. - COS (PIE*(I-1.)/NVOR))
VORS(1, I) = X1 + X00 + RATIO * (DELTAX + XERP)
VORS(2, I) = Y1 + DELTAY * RATIO
310 VORS(3, I) = ZZ0 + RATIO * (ZZ + DELTAZ) + Z1

C
DO 501 I = NVOR1, NVRN, NVOR1
IF (LAX, EQ, 1) PCORD = (I / NVOR1 * 4.0 - 3.0) / N4
IF (LAX, EQ, 0) PCORD = 5 * (1. - COS((Z2 * I / NVOR1 - 1.) * PIE / N2))
CALL INTERP(PCORD, ZZ0, ZZ, X00, XERP)
DO 501 J = 2, NVOR1
I2 = I + J + IFUG
IF (LAX, EQ, 1) RATIO = (J-1.)/NVOR
IF (LAX, EQ, 0) RATIO = 5 * (1. - COS (PIE*(J-1.)/NVOR))
READS 111
READS 112
READS 113
READS 114
READS 115
READS 116
READS 117
READS 118
READS 119
READS 120
READS 121
READS 122
READS 123
READS 124
READS 125
READS 126
READS 127
READS 128
READS 129
READS 130
READS 131
READS 132
READS 133
READS 134
READS 135
READS 136
READS 137
READS 138
READS 139
READS 140
READS 141
READS 142
READS 143
READS 144
READS 145
READS 146
READS 147
APPENDIX

THIS SECTION OF THE PROGRAM CALCULATES THE LOCATION OF THE
CONTROL POINTS FOR A FLAT PANEL SUCH AS A WING. IT THEN
PLACES AN "X" ON EACH POINT.

PRD=NVOR*RNVC
NNO=(RNVC-1)*NVOR+1
NNN=PRD+4
ISETFS=ISETSF(NNN)
WRITE(4,NVOR,RNVC,PRD,NNN,NNO,NNO,ISETFS)
CALL SAVE(IFUG,4,IDUM,1)
DO 1001 I=1,NNO,NVOR
K=(I-1)/NVOR+1
IF(LAX.EQ.0)PCORD=.5*(1-COS(K*PIE/RNVC)))
IF(LAX.EQ.0)PCORD=(4.*K-1.)/N4
CALL INTERP(PCORD,ZZ1,ZZ,XOO,XERP)
YRAT=SQRT(DELTAY*DELTAY+(DELTAZ+ZZ)**2.)
V1=CROSSIZ*DELTAY/YRAT
VZ=CROSSIZ*(DELTAZ+ZZ)/YRAT
DO 1001 J=1,NVOR
J2=(I+J-2)*4+IFUG
J21=J2+1
J22=J2+2
J23=J2+3
J24=J2+4
IF(LAY.EQ.1)RATIO=(J-.5)/NVOR
IF(LAY.EQ.0)RATIO=.25*(2.*COS(PI*J/NVOR)-COS(PI*(J-1.)/NVOR))
CALL ANGLE(RATIO,WS,WC)
XCORD=CD1*COS+DELTAO*COS
TEMX=X1+RATIO*(DELTAX*XERP)+PCORD*XCORD+X00
VORS(1,J21)=TEMX-CROSSIZ*WC
VORS(1,J22)=TEMX+CROSSIZ*WC
VORS(1,J23)=VORS(1,J24)=TEMX
TEMY=Y1+DELTAY*RATIO
VORS(2,J21)=VORS(2,J22)=TEMY
TEMZ=Z1+DELTAZ*RATIO
TEMZ=TEMZ+ZZG+ZZ*RATIO
VORS(3,J21)=TEMZ-CROSSIZ*WS
VORS(3,J22)=TEMZ+CROSSIZ*WS
VORS(3,J23)=TEMZ-V2
VORS(3,J24)=TEMZ+V2
VORS(2,J23)=TEMY-V1
VORS(2,J24)=TEMY+V1
IF(J24.EQ.500)CALL SAVE(IFUG,4,IDUM,2)
1001 CONTINUE
CALL SAVE(IFUG,4,NNN,3)
1010 CONTINUE
RETURN
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *  
C ** THIS SECTION OF THE PROGRAM IS FOR CURVED MAJOR PANELS. **
C 5 YNOT=Y(1)-RO(1)*COS(PHI(1))
ZNOT=Z(1)-RO(1)*SIN(PHI(1))
TEMP=X1+CORD1
C ** THIS CALCULATES THE SCALING FACTORS FOR THE RADIUS VECTORS **
C FROM AREA RATIOS.
IF(NAP.LE.2)GO TO 90
DO 84 J=1,NAP
  READS 186
  READS 187
  READS 188
  READS 189
  READS 190
  READS 191
  READS 192
  READS 193
  READS 194
  READS 195
  READS 196
  READS 197
  READS 198
  READS 199
  READS 200
  READS 201
  READS 202
  READS 203
  READS 204
  READS 205
  READS 206
  READS 207
  READS 208
  READS 209
  READS 210
  READS 211
  READS 212
  READS 213
  READS 214
  READS 215
  READS 216
  READS 217
  READS 218
  READS 219
  READS 220
  READS 221
  READS 222
  READS 223
89 ZC(C,J) = SQRT(ZC(2,J)*.01)
C
THIS SECTION CALCULATES THE LOCATION OF A SET OF POINTS THAT
DESCRIBE A CURVED MAJOR PANEL SUCH AS A FUSELAGE OR A NACELLE
WITH SUBPANELING.
C
90 CALL INTERP2(0.0,XSHIFT1,SKAL1,DM,DM,ZSHIFT1,DM,9H NO POINT)
CALL SAVE(IFUG5,5,IDUM,1)
ISETS=ISETSF(NVNRNPRD)
WRITE(5)NVOR,RNCV,NVNRNPRD,ISETS
DO 1333 I=1,NVOR1
R=RO(I)
FI PHI(I)
VORS(1,I)*X1
VORS(2,I)*R*COS(FI)*SKAL1*YNOT
VORS(3,I)*R*SIN(FI)*SKAL1*ZNOT+ZSHIFT1
1333 DO 1501 J=1,NVOR1
IF(LAX.EQ.0)PCORD=(I/NVOR1*4.-3.)/N4
IF(LAX.EQ.0)PCORD=(1.0*COS(2.*I/NVOR1-1.)*PIE/N2))
CALL INTERP2(PCORD,XSHIFT,SKAL,DM,DM,ZSHIFT,DM,9H NO POINT)
XTEMP=X1*XSHIFT
DO 1501 J=1,NVOR1
IZ=I+J+IFUG
R=RO(J)**SKAL
FI PHI(J)
VORS(1,IZ)=XTEMP
VORS(2,IZ)*R*COS(FI)*YNOT
VORS(3,IZ)*R*SIN(FI)*ZNOT+ZSHIFT
1501 IF(IZ.EQ.500)CALL SAVE(IFUG5,5,IDUM,2)
CALL INTERP2(1.0,XSHIFT2,SKAL2,DM,DM,ZSHIFT2,DM,9H NO POINT)
DO 1300 I=1,NVOR1
IZ=NVNR1+NVOR1+1+IFUG
R=RO(I)
FI PHI(I)
VORS(1,IZ)=T-MP2
VORS(2,IZ)*R*SKAL2*COS(FI)*YNOT
VORS(3,IZ)*R*SKAL2*SIN(FI)*ZNOT+ZSHIFT2
1300 IF(I2.EQ.500)CALL SAVE(IFUG,5,IDUM,2)
     CALL SAVE(IFUG,5,NVRNPRD,3)
C
C THIS SECTION CALCULATES THE LOCATION OF A SET OF POINTS THAT
C DESCRIBE A CURVED MAJOR PANEL, WITHOUT SUBPANELING.
     NVRN=(NAP)*(NVOR+1)
     NVRNPRD=(NAP)*(NVOR+1)
     ISETS=ISETS+(NVRNPRD)
     WRITE(3)NVOR,NAP,POD,1QUANT,NVRNPRD,ISETS
     CALL SAVE(IFUG,3,NVRNPRD,1)
     IF(NAP.LE.2)GO TO 556
     DO 555 I=1,NVRN,NVOR1
         II=(I)/NVOR1+1
         XTEMP=X1+CORD1*XAF(II)
         SKAL=ZC(2,II)
         DO 555 J=1,NVOR1
             R=RO(J)*SKAL
             FI=PHI(J)
             I2=I+J-1+IFUG
             VORS(1,I2)=XTEMP
             VORS(2,I2)=R*COS(FI)*YNOT
             VORS(3,I2)=R*SIN(FI)+2NOT+COD1*01*ZC(1,II)
     IF(I2.EQ.500)CALL SAVE(IFUG,3,IDUM,2)
     IF(NAP.GT.2)GO TO 5555

5555 NAP=2
     NVRNPRD=NAP*NVOR1
     DO 5554 J=1,NVOR1
         J2=J+NVOR1
         VDP(S,1,J)=X1
         VORS(1,J2)=X1+CORD1
         VORS(2,J)=VORS(2,J2)-YNGT+RO(J)*COS(PHI(J))
         VORS(3,J)=VORS(3,J2)-ZNOT+RO(J)*SIN(PHI(J))
     CALL SAVE(IFUG,3,NVRNPRD,3)
C
C THIS SECTION CALCULATES THE LOCATION OF THE CONTROL POINTS FOR
C A CURVED MAJOR PANEL. IT THEN PLACES AN "X" ON EACH POINT.
     POD=PO(1)
     DO 2610 N=1,NVOR
AZO = RO(N) * SIN(PHI(N))
AZ1 = RO(N+1) * SIN(PHI(N+1))
AYO = RO(N) * COS(PHI(N))
AY1 = RO(N+1) * COS(PHI(N+1))
DAZ = AZO - AZ1
DAY = AYO - AY1
H = SQRT(DAZ * DAZ + DAY * DAY)
SINE(N) = DAZ / H
COSINE(N) = DAY / H
R1 = RO(N)
R2 = RO(N+1)
F1 = PHI(N)
F2 = PHI(N+1)
RO(N) = (R1 * SIN(F1) + R2 * SIN(F2)) * 5

2010

PHI(N) = (R1 * COS(F1) + R2 * COS(F2)) * 5

PRD = NVOR * RNCV
NNO = (RNCV - 1) * NVOR + 1
NNN = PRD * 4
ISETS = ISETSF(NNV)
WRITE(4, NVOR, RNCV, PRD, NNN, NNO, ISETS)
CALL SAVE(IFUG, IQ, IO, I)
DO 2001 I = 1, NVOR
K = (I - 1) / NVOR + 1
IF(LAX EQ 0) PCORD = 5 * (1. - COS(K * PIE / RNCV))
IF(LAX EQ 1) PCORD = (4. * Y - 1.) / N4
CALL INTERP2(PCORD, TEMX, SKAL, DSKL, CROSX, CAMB, DZ, 6HPINTS)
TEMX = TEMX + X1
DO 2001 J = 1, NVOR
J2 = (I + J - 2) * 4 + IFUG
J21 = J2 + 1
J22 = J2 + 2
J23 = J2 + 3
J24 = J2 + 4
VS = SINE(J) * CROSSIZ
HS = COSINE(J) * CROSSIZ
TMY = PHI(J) * SKAL + NOT
TY2 = DSKL * PHI(J)
TEMZ = RO(J) * SKAL + ZNOT + CAMB
\texttt{TZ2=RQ(J)+DQK+DZ} \begin{array}{c}
\texttt{VORS(1, J21)=TEMX-CROSSX} \\
\texttt{VORS(1, J22)=TEMX+CROSSX} \\
\texttt{VORS(1, J23)=TEMX} \\
\texttt{VORS(1, J24)=TEMX} \\
\texttt{VORS(2, J2)=TEMY-TY2} \\
\texttt{VORS(2, J22)=TEMY+TY2} \\
\texttt{VORS(2, J23)=TEMY-HS} \\
\texttt{VORS(2, J24)=TEMY-HS} \\
\texttt{VORS(3, J21)=Tc.:7-TZ2} \\
\texttt{VORS(3, J22)=TEMZ+T22} \\
\texttt{VORS(3, J23)=TEMZ-VS} \\
\texttt{VORS(3, J24)=TEMZ+VS} \\
\texttt{IF(J24 .EQ. 500) CALL SAVE(IFUG, 4, IDUM, 2)} \end{array}
2001 \texttt{CONTINUE}
\texttt{CALL SAVE(IFUG, 4, NNN, 3)}
\texttt{RETURN}
\texttt{END}

\texttt{SUBROUTINE INTERP(P, ZA, Z, YA, X)}
\texttt{THIS SUBROUTINE DOES THE INTERPOLATION FOR CAMBER OF A FLAT}
\texttt{MAJOR PANEL.}
\texttt{COMMON/BLOKONAP, XAF(50), ZC(2, 50), CORD1, CORD2, COS1, COS2, DELTAY}
\texttt{COMMON/CANDS/SIN1, SIN2, COS1, COS2, DELTAY}
\texttt{COMMON/TWIST/AINC, DAINC}
\texttt{COMMON/SLOPE/ANGL, DANG}
\texttt{IF(NP .LE. 2 .OR. DELTAY .EQ. 0.0) GO TO 3}
\texttt{DO 1 I=2, NAP}
1 \texttt{IF(P .LE. XAF(I)) GO TO 2}
2 \texttt{DAF=XAF(I)-XAF(I-1)}
\texttt{DZC1=ZC(1, I)-ZC(1, I-1)}
\texttt{DZC2=ZC(2, I)-ZC(2, I-1)}
\texttt{A1=ATAN(DZC1/DAF)}
\texttt{A2=ATAN(DZC2/DAF)}
\texttt{DA=A2-A1}
\texttt{PC=(P-XAF(I-1))/DAF}
\texttt{CAMS1=(DZC1*PC+ZC(1, I-1))*CORD1*C1}

\texttt{READS 338}
\texttt{READS 339}
\texttt{READS 340}
\texttt{READS 341}
\texttt{READS 342}
\texttt{READS 343}
\texttt{READS 344}
\texttt{READS 345}
\texttt{READS 346}
\texttt{READS 347}
\texttt{READS 348}
\texttt{READS 349}
\texttt{READS 350}
\texttt{READS 351}
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\texttt{READS 361}
\texttt{READS 362}
\texttt{READS 363}
\texttt{READS 364}
\texttt{READS 365}
\texttt{READS 366}
\texttt{READS 367}
\texttt{READS 368}
\texttt{READS 369}
\texttt{READS 370}
\texttt{READS 371}
\texttt{READS 372}
\texttt{READS 373}
CAMB2*(DZC2*PC+ZC(Z, I-1))*CORD2*.01
GO TO 4
3 CAMB1=CAMB2=A1=DAA=0.0
4 DANG=DAA+DAINC
ANGLE=AINC1+A1
ZA=CAMB1*COS1+P*CD1SIN
ZB=CAMB2*COS2+P*CD2SIN
Z=ZB-ZA
XA=-CAMB1*SIN1
XB=-CAMB2*SIN2
X=XB-XA
RETURN
END

SUBROUTINE INTERP2(P, X, S, DS, CROS, Z, DZ, TEST)
C
THIS SUBROUTINE DOES THE INTERPOLATION FOR THE RADIUS VECTORS
C
AND THE CAMBER OF A CURVED MAJOR PANEL.
COMMON/BLOK0/NAP,XAF(50),ZC(2,50),CORD1,CORD2,CD1SIN,CD2SIN
COMMON/ROJ1,ROJ1,CROSSIZ
X=P*CORD1
IF(NAP.LE.2)GO TO 3
DO 1 I=2,NAP
1 IF(P.LE.XAF(I))GO TO 2
2 DAF=XAF(I)-XAF(I-1)
DZC1=ZC(1, I)-ZC(1, I-1)
DZC2=(ZC(2, I)-ZC(2, I-1))
PC=(P-XAF(I-1))/DAF
S=ZC(2, I-1)+DZC1*PC
Z=ZC(1, I-1)+DZ1*PC
Z=Z*.01*CORD1
IF(TEST.NE.6HPINTS)RETURN
DRAD=ROJ1*DZC2
DELX=DAF*CORD1
COSINE=DELX/SQRT(DRAD*DRAD+DELX*DELX)
CROS=COSINE*CROSSIZ
P2=CROS/CORD1
READS 374
READS 375
READS 376
READS 377
READS 378
READS 379
READS 380
READS 381
READS 382
READS 383
READS 384
READS 385
READS 386
READS 387
READS 388
READS 389
READS 390
READS 391
READS 392
READS 393
READS 394
READS 395
READS 396
READS 397
READS 398
READS 399
READS 400
READS 401
READS 402
READS 403
READS 404
READS 405
READS 406
READS 407
READS 408
READS 409
PC2=(P+P2-XAF(I-1)/DAF
S2=ZC(2,I-1)+DC2*PC2
Z2=ZC(I,I-1)+DC1*PC2
Z2=Z2+CORD1*.01
DZ=Z2-Z
DS=S2-S
RETURN
S=S2=1.0
Z=DS=DZ=0.0
CROS=CROSSZ
RETURN
END

SUBROUTINE ANGLE(R,S,C)
C THIS SUBROUTINE IS USED FOR PLACING X'S ON CONTROL POINTS,
C ON FLAT MAJOR PANELS.
COMMON/SLOPE/ANGLE,DANG
ANG=ANGL+R*DANG
S=SIN(ANG)
C=COS(ANG)
RETURN
END

SUBROUTINE ZEROZC1(PDL)
C THIS SUBROUTINE REMOVES CAMBER FROM THE MAJOR PANELS.
COMMON/BLOKO/NAP,XAF(50),ZC(2,50),CORD1,CORD2,CD1SIN,CD2SIN
DO 1 I=1,2
IF(I.EQ.2.AND.PDL.GE.360.)RETURN
DO 1 J=1,NAP
1 ZC(I,J)=0.0
RETURN
END
FUNCTION ISETSF(N)
C THIS FUNCTION DETERMINES THE NUMBER OF DATA SETS NEEDED TO
C DESCRIBE A MAJOR PANEL.
R=1.0/500.*N
ISETSF=INT(R)
IF(ISETSF.LT.R)ISETSF=ISETSF+1
RETURN
END

SUBROUTINE SAVE(FUG,FILE,PROD,TEST)
C THIS SUBROUTINE MAKES IT POSSIBLE TO REDUCE CORE REQUIREMENTS
C BY REDUCING ARRAY SIZE.
INTEGER FUG,FILE,PNTS,TEST,PROD
COMMON VORS(3,500)
IF(TEST.EQ.2)GO TO 2
IF(TEST.EQ.3)GO TO 3
FUG=0
RETURN
2 FUG=FUG-500
WRITE(FILE,'(',VORS(I,J),I=1,3),J=1,500)
RETURN
3 PNTS=MOD(PROD,500)
IF(PNTS.EQ.0)RETURN
WRITE(FILE,'(',VORS(I,J),I=1,3),J=1,PNTS)
RETURN
END

SUBROUTINE SIZES(NPAN,LENGTH,XOFFSET,WIDTH)
C ** DETERMINES THE LENGTH, WIDTH, STARTING POINT OF THE
C ** AIRCRAFT.
REAL LENGTH
NPAN2=NPAN-1
CALL FIND(LENGTH,XOFFSET,WIDTH)
IF(NPAN.EQ.1)GO TO 8

APPENDIX B - Continued
DO 7 I=1,NPAN2
CALL FIND(BIG,SMALL,WIDE)
IF(SMALL,LT,XOFFSET)XOFFSET=SMALL
IF(WIDE,GT,WIDTH)WIDTH=WIDE
7 IF(BIG,GT,LENGTH)LENGTH=BIG
WIDTH=WIDTH+2.0
LENGTH=LENGTH-XOFFSET
8 REWIND 1
READ(1,5)
5 FORMAT(///)
RETURN
END

SUBROUTINE FIND(BIG,SMALL,WIDE)
C ** DETERMINES THE STARTING POINT, END POINT, AND
C ** DISTANCE FROM THE AXIS FOR A PANEL.
COMMON/BLOKO/NAP,XAF(50),ZC(2,50),CORD1,CORD2,CD1SIN,CD2SIN
COMMON/PHIRO/ PHI(100),RO(100),SINE(100),COSINE(100)
READ(1,100)X1,Y1,Z1,CORD1
READ(1,100)X2,Y2,Z2,CORD2
Y1=ABS(Y1)
Y2=ABS(Y2)
READ(1,101)TVOR,INCV,PDL
NVOR=INT(TVOR)+1
IF(PDL,LE,360.0)GO TO 1
READ(1,102)(PHI(N),RO(N),N=1,NVOR1)
1 READ(1,103)AINC1,AINC2,ITS,NAP,IOUANT,ISYNT,NPP
IF(ISYNT,NE,0)READ(1,104)
IF(NAP,LE,2)GO TO 2
READ(1,102)(XAF(I),I=1,NAP)
IF(ITS,LE,0,OR,PDL,GE,360.0)GO TO 3
READ(1,105)R
3 READ(1,102)(ZC(1,I),I=1,NAP)
IF(ITS,LE,0,OR,PDL,GE,360.0)GO TO 4
READ(1,105)R

APPENDIX B. - Continued
4 READ(1,102)(ZC(2,I),I=1,NAP)
  2 CONTINUE
100 FORMAT(4F10.0)
101 FORMAT(2F10.0,10X,F10.0)
102 FORMAT(8F10.0)
103 FORMAT(2F10.0,12,8X,12,9X,11,9X,11,9X,11)
104 FORMAT(/)
105 FORMAT(F10.0)
  C
    SMALL=X2
    IF(X1.LT.SMALL)SMALL=X1
11 X1=X1+CORD1
    X2=X2+CORD2
    BIG=X2
    IF(X1.GT.BIG)BIG=X1
    WIDE=Y1
    IF(Y2.GT.WIDE)WIDE=Y2
RETURN
END
APPENDIX C
SOURCE LISTING OF PROGRAM PLOTS

PROGRAM PLOTS (INPUT, OUTPUT, TAPE2=OUTPUT, TAPE3=TAPE4, TAPE5)

C

THIS INITIALIZES THE PLOTTING ROUTINES AND CALLS PLOTPAN.

CALL INITT(120)
CALL TERM(3, 4096)
CALL CHRSIZ(4)
CALL PLOTPAN
CALL FINITT(0, 0)
STOP
END

C

SUBROUTINE PLOTPAN
COMMON VORS(3, 500)
COMMON /PRAMS/NVOR, NVRNP, RNCV, NVOR1, NVRN
COMMON /TITL/TITLE(6)
COMMON /RAT/KARRAY(3)
INTEGER RNCV

C

THIS PROGRAM READS A SET OF 3 ANGLES AND PLOTS THE
CONFIGURATION AFTER ROTATING IT THROUGH THE INDICATED ANGLES.
FIRST ONE SIDE IS PLOTTED THEN IT IS REFLECTED THROUGH
ITS X-Z PLANE AND THE OTHER SIDE IS PLOTTED.
THE ROTATIONS ARE CARRIED OUT BY MATRIX MULTIPLICATION.
IT IS ALSO DETERMINED IF THE SUBPANELING AND CONTROL
POINTS ARE TO BE SHOWN.

C

LOGICAL SUBLINE, CPJNHTZ
DATA (KARRAY2(M), M=1, 7) /20, 3, 3, 500, 3, 3, 3/
DATA PIE /3.14159/

C

REWRITE 3
REWRITE 4
REWRITE 5
APPENDIX C.

HERE THE ANGLES OF ROTATION ARE READ; ROLL, PITCH, AND YAW, ARE READ.

CALL ERASE
WRITE(2,104)
READ *,ROLL
IF(ROLL.GT.360.)RETURN
WRITE(2,105)
READ *,PITCH
WRITE(2,106)
READ *,YAW
WRITE(2,107)
READ 112,SUBLINE
WRITE(2,108)
READ 112,CPONITZ
104 FORMAT(" INPUT THE ROLL ANGLE FOR THE AIRCRAFT",/,,"
2"(DEG),>360 TO STOP.")
105 FORMAT("PITCH ANGLE")
106 FORMAT("YAW ANGLE")
107 FORMAT("SUBPANELING? TRUE OR FALSE")
108 FORMAT("CONTROL POINTS? TRUE OR FALSE")
112 FORMAT(L7)

! IF(ESTRTO.LT.1.00)GO TO 500
! IF(ESTRTO.GT.1.25)ESTRTO=1.25
! RYY*5.0/ESTRTO
! IXX2=INT(ESTRTO*3200)
! IXX1=INT((4096-IXX2)*.5)
! CALL SWINDO(IXX1,IXX2,1,3200)
! CALL DWINDO(-5.0,5.0,-RYY,RYY)
! GO TO 501
500 CALL SWINDO(450,3200,1,3200)
 CALL DWINDO(-5.0,5.0,-5.0,5.0)
501 CALL TURNIT('ROLL,PITCH,YAW')
 3 CALL MOVABS(100,3500)
 CALL ANMODE
WRITE(2,788) TITLE, ROLL, PITCH, YAW
788 FORMAT(8(A10,1X,3H,",","F7.1," ))
1/", " THE ROLL ANGLE IS ",F7.1,"
2/", " THE PITCH ANGLE IS "F7.1",
DO 300 NPANS=1,NPAN
DO 299 L=1,2
READ(3)NVOR, RNCV, PDLO, IQUANT, NVRNP, ISets
ISET=ISets
NVOR1=NVOR+1
NVOR=NVRNP-NVOR1+1
IF (SUBLINE.A,,PDLO.LT.350) CALL VORSUB(5Hlines,ISets,3,L)
IF (.NOT.,SUBLINE.A,,PDLO.LT.360) CALL VORSUB(5Hlines,ISets,3,L)
IF (SUBLINE.A,,PDLO.GT.350) CALL RVDSUB(L)
IF (.NOT.,SUBLINE.A,,PDLO.GT.350) CALL RVDSUB(5Hedges,ISets,3,L)
IF (PDLO.GT.0,0,0,0,PONTS) CALL CPOINTS(L)
IF (SUBLINE.A,,PDLO.GT.360,0,ISET*)
IF (L.EQ.2, OR, IQUANT.EQ.1) GO TO 300
CALL BACKUP(ISets+1)
299 CONTINUE
300 IF (L.EQ.2, A, ISET.EQ.0, OR, IQUANT.EQ.1, A, ISET.EQ.0) CALL SKIPFILE(3, ISets)
CALL MOVABS(100,3500)
CALL BIGER(III)
IF (II-1)9,9,3
END

C

SUBROUTINE VORSUB(WHICH,ISets,IFILE,L)
COMMON /PRAMS/NVOR,NVPRN,PRNCR,NVOR1,NVRN
COMMON VORS(3,500)
C
C THIS SUBROUTINE PLOTS A FLAT MAJOR PANEL WITH
CR WITHOUT SUBPANELING, OR A CURVED PANEL WITHOUT SUBPANELING.
C
CALL SAVE(IFUG,IFILE,1,1,ISets)
IF (WHICH.EQ.5) GO TO 1
N1=NVRN-1
C
APPENDIX C. - continued

OF POOR QUALITY
N2=NVOR
GO TO 2
1 N1=NVOR1
N2=1
2 CALL SAVE(IFUG,IFILE,NVRNPRD,2,L,ISETS)
DO 257 I=1,NVRN,N1
DO 257 J=1,NVOR1
IZ=I+J-1+IFUG
IF(IZ.LE.500)GO TO 3
10 IF(IZ.EQ.500)GO TO 10
CALL SAVE(IFUG,IFILE,NVRNPRD,2,L,ISETS)
IF(IZ.GT.500)GO TO 10
3 IF(J.EQ.1)CALL MOVEA(VORS(1,I2),VORS(3,I2))
DO 257 CALL DRAWA(VORS(1,I2),VORS(3,I2))
DO 257 I=1,NVRN1,N2
IF(ISETS.EQ.1)GO TO 4
CALL BACKUP(IFIL,ISETS)
CALL SAVE(IFUG,IFILE,NVRNPRD,1,L,ISETS)
CALL SAVE(IFUG,IFILE,NVRNPRD,3,L,ISETS)
4 DO 257 I=1,NVRN1
IZ=I+J-1+IFUG
IF(IZ.LE.500)GO TO 3
CALL SAVE(IFUG,IFILE,NVRNPRD,3,L,ISETS)
IF(IZ.GT.500)GO TO 10
5 IF(I.EQ.1)CALL MOVEA(VORS(1,I2),VORS(3,I2))
DO 257 CALL DRAWA(VORS(1,I2),VORS(3,I2))
RETURN
END
C
SUBROUTINE REFLECT(N)
COMMON VORS(3,500)
C THIS SUBROUTINE REFLECTS THE CONFIGURATION ACCROSS ITS X-Z PLANE.
DO 1 J=1,N
1 VORS(2,J)=VORS(2,J)
RETURN
END
SUBROUTINE BIGER(I)

This subroutine causes a portion of the plot defined with
the graphics cursor, to be enlarged.

CALL ANMODE
WRITE(2,103)
READ 102,ENLARGE
IF(ENLARGE.EQ.'YES')GO TO 1
I=1
RETURN
1 CALL VCUPSR(ICHAR,X1,Y1)
CALL VCURSR(ICHAR,X2,Y2)
CALL FPAS1
RATIO=(X2-X1)/(Y2-Y1)
IF(RATIO.LT.1.25)GO TO 10
IX1=4F
IX2=4G+7
IY1=INT((4+40*RATIO))
IY2=INT((3200-IY2)*.5)
GO TO 21
10 IY1=1
IY2=3200
IX2=INT(3200*RATIO)
IX1=INT((4096-IX2)*.5)
20 CALL SWINDD(IX1,IX2,IY1,IY2)
CALL DWINDD(X1,X2,Y1,Y2)
REWIND 3
REWIND 4
REWIND 5
READ(3)
I=2
RETURN
102 FORMAT(1A3)
103 FORMAT(//////," FOR ENLARGEMENT INPUT YES")
END
SUBROUTINE CPOINTSL

THIS SUBROUTINE PLOTS X'S ON THE CONTROL POINTS.

COMMON VORS(3,500)
COMMON/PRAMS/NVOR,NVRNPRD,RNCV,NVOR1,NVRN
INTEGER PRD,RNCV
IF(L.EQ.2)CALL BACKUP(4,ISETS+1)
READ(4)NVOR,RNCV,PRD,NNN,NVRNPRD,NNO,ISETS
CALL SAVE(IIFUG,4,IDEU1,1,L,ISETS)
CALL SAVE(IIFUG,4,NNN,2,L,ISETS)
DO 1 J=1,NNO,NVOR
DO 1 I=1,NVOR
K=(I+J-2)*4+IIFUG
K4=K+4
CALL MOVEA(VORS(1,K+1),VORS(3,K+1))
CALL DRAWA(VORS(1,K+2),VORS(3,K+2))
CALL MOVEA(VORS(1,K+3),VORS(3,K+3))
CALL DRAWA(VORS(1,K+4),VORS(3,K+4))
1 IF(K4.EQ.500)CALL SAVE(IIFUG,4,NNN,2,L,ISETS)
RETURN
END

SUBROUTINE PLINE1(L)

THIS DEFINES A SET OF PARAMETERS SO A CURVED MAJOR

PANEL WITH SUBPANELING CAN BE PLOTED.

INTEGER RNCV
COMMON VORS(3,500)
COMMON/PRAMS/NVOR,NVRNPRD,RNCV,NVOR1,NVRN
IF(L.EQ.2)CALL BACKUP(5,ISETS+1)
READ(5)NVOR,RNCV,NVRNPRD,ISETS
NVOR1=NVOR+1
NVRN=NVRNPRD+1VOR
CALL VORSUB(5,LINES,ISETS,5,L)
RETURN
END
SUBROUTINE SAVG(FUG,FILE,P,TEST,L,SETS)

C THIS SUBROUTINE MAKES IT POSSIBLE TO REDUCE THE CORE

C REQUIREMENTS OF THE PROGRAM.

INTEGER FUG,FILE,P,TEST,SETS
COMMON VORS(3,500)
COMMON /PRAMS/NVOR,NVRNPRD,RNCV,NVOR1,NVRN
COMMON/ROT/KARRAY2(7),AMYTRIX(3,3)
IF(TST.EQ.1)GO TO 1
FUG=500*TEST2
IF(TST2.EQ.SETS)RETURN
TEST2=TEST2+1
IF(TST2.LT.SETS)N=500
IF(TST2.EQ.SETS)N=MOD(P,500)
IF(N.EQ.0)N=500
READ(FILE)((VORS(I,J),I=1,3),J=1,N)
IF(L.EQ.2)CALL REFLECT(N)
KARRAY2(4)=N
CALL MATOPS(KARRAY2,AMYTRIX,VORS,VORS)
RETURN
1 TEST2=FUG*O
RETURN
END

C

SUBROUTINE BACKU(I,N)

C CAUSES FILE I TO BE BACKSPACED N RECORDS.

DO 1 J=1,N
1 BACKSPACE I
RETURN
END
ZAX(1,1)=ZAX(2,2)=COS(P)
SINE=SIN(P)
ZAX(1,2)=-SINE
ZAX(2,1)=SINE
R1(2,2)=R1(3,3)=COS(RTO)
SINE=SIN(RTO)
R1(2,3)=SINE
 R1(3,2)=-SINE
CALL.MATOPS(KMULT, XAX, AMYRIX, AMYRIX)
CALL.MATOPS(KMULT, R1, AMYRIX, AMYRIX)
CALL.MATOPS(KMULT, ZAX, AMYRIX, AMYRIX)
  TRANSPOSE MAYRIX R1.
R1(2,3)=-SINE
R1(3,2)=SINE
CALL.MATOPS(KMULT, R1, AMYRIX, AMYRIX)
ZAX(1,1)=ZAX(2,2)=COS(Y)
SINE=SIN(Y)
ZAX(1,2)=-SINE
ZAX(2,1)=SINE
CALL.MATOPS(MULTV, AMYRIX, VECTOR, VECTOR)
A=VECTOR(1)
B=VECTOR(2)
C=VECTOR(3)
V=SQR(T(B*B+C*C)
B0V=V=V/V
R1(2,2)=R1(3,3)=V/V
R1(2,3)=-B0VRV
R1(3,2)=B0VRV
R2(1,2)=R2(3,3)=V
R2(1,3)=-A
R2(3,1)=A
CALL.MATOPS(KMULT, R1, AMYRIX, AMYRIX)
CALL.MATOPS(KMULT, R2, AMYRIX, AMYRIX)
CALL.MATOPS(KMULT, ZAX, AMYRIX, AMYRIX)
  TRANSPOSE MAYRIX R1 AND MAYRIX R2.
R1(2,3)=B0VRV
APPENDIX C. - Concluded
Laminar flow aircraft ACE-1 8/28/77
The roll angle is 0.0
The pitch angle is 0.0
The yaw angle is 0.0

For enlargement input YES

(d) With subpaneling.

Figure 1. - Continued.
Figure 1. - Continued.

(e) With control points.
DO YOU WANT CAMBER IN THE PANELS?
TRUE OR FALSE
? TRUE

INPUT THE ROLL ANGLE FOR THE AIRCRAFT
(DEG), >360 TO STOP.
? 11
PITCH ANGLE
? 12
YAW ANGLE
? 13
SUBPANELING? TRUE OR FALSE
? TRUE
CONTROL POINTS? TRUE OR FALSE
? TRUE

Figure 2. - Sample execution of program PLOTIT.
Figure 3. - Plot from sample execution in figure 2.
(a) First location of graphics cursor.

Figure 4. - Use of graphics cursor to enlarge a section of a configuration plot.
(c) Enlarged plot resulting from cursor locations in figure 4 part (a) and part (b).

Figure 4. - Concluded.